Energy Innovation Summit 2024

ENSIGN
Energy System dIGital twiN
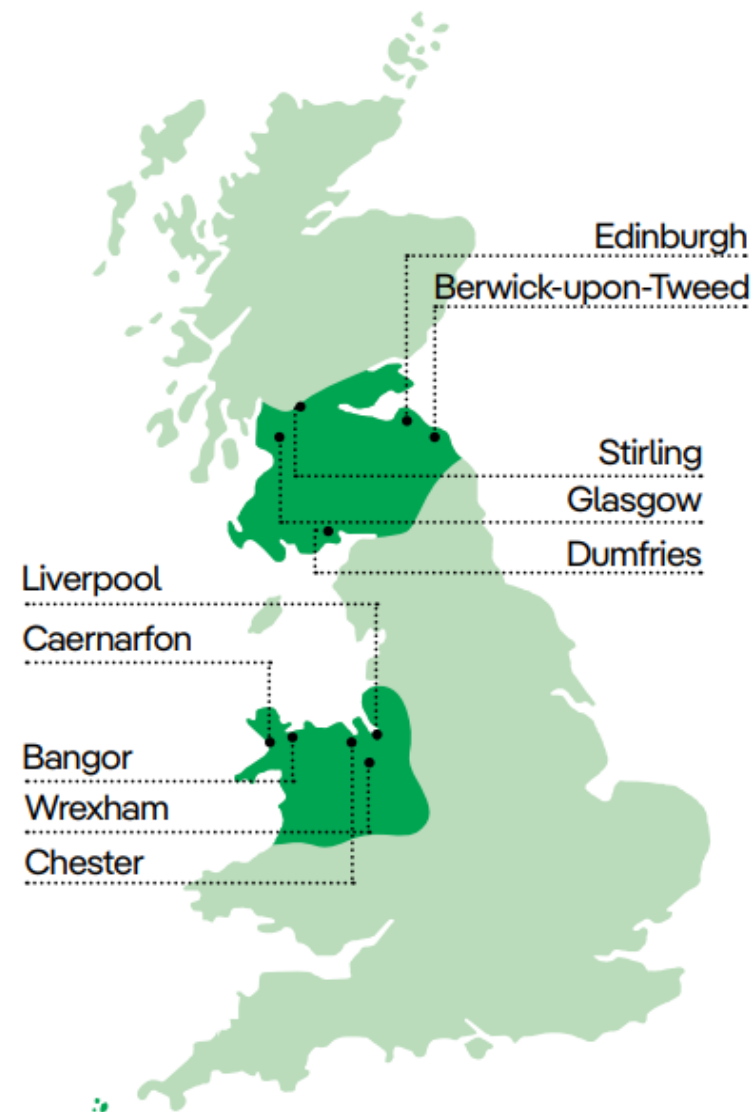
SP Energy Networks

About us

We are SP Energy Networks. As a Distribution and Transmission Network Operator we keep electricity flowing to homes and businesses throughout Central and Southern Scotland, North and Mid Wales, Merseyside, Cheshire and North Shropshire.

We do this through the network of Overhead Lines and Underground Cables which we own and maintain. No matter who you pay your bill to, we're the people to contact if you have a power cut, need a new or upgraded power connection or spot an issue with our equipment.

Our three regulated electricity businesses are:

- SP Transmission PLC (SPT)
- SP Distribution PLC (SPD)
- SP Manweb PLC (SPM)

Edinburgh
Berwick-upon-Tweed
Stirling
Glasgow
Dumfries
Liverpool
Caernarfon
Bangor
Wrexham
Chester

ENSIGN – A Prosperity Partnership Research Project

SP Energy Networks

Launched in 2023, ENSIGN is a pioneering initiative that intersects digital innovation, energy system transformation, and asset management.

Objective: To create a comprehensive **digital twin** of the energy system.

- Design & Develop **Reliable & Affordable net-zero energy system**.

1) **SPEN** is the initiator and matched funding.
1) **SPEN** has made significant contributions in terms of financial commitments, resources & expertise.

- Cost reduction
- Improved network resilience
- New products and services.

- Working with internal and external stakeholders to **maximise the impact of the project**.

Research Aims and Challenges

Funding and Contributions

Benefits and Outcomes

Collaboration and Impact

ENSIGN - Academic Research Streams

SP Energy Networks

EPSRC
Engineering and Physical Sciences Research Council

UKRI
Engineering and Physical Sciences Research Council

University of Strathclyde Glasgow

HERIOT WATT UNIVERSITY

University of St Andrews

UNIVERSITY OF LIVERPOOL

Electricity

Industrial/AI

Hydrogen

Heat

- ENSIGN involves four leading UK universities - Strathclyde, Liverpool, Heriot Watt and St Andrews.

- The project is expected to deliver new knowledge and understanding of future energy systems and create more than 20 new highly skilled academic research jobs and PhD positions.

- For the UK, the ENSIGN project's benefit lies in its contribution to the country's goal of achieving net zero emissions by 2050.

- By developing a digital twin for the energy system, the project will support the design and operation of future decarbonised energy systems.

- This will help address industry-driven challenges and deliver economic and societal impact for sustainability and prosperity.

ENSIGN – ENergy System dIGital twiN

- **Using Digital Technologies to Deliver Enhanced Customer Service**
- **Optimised Asset and Network Management**
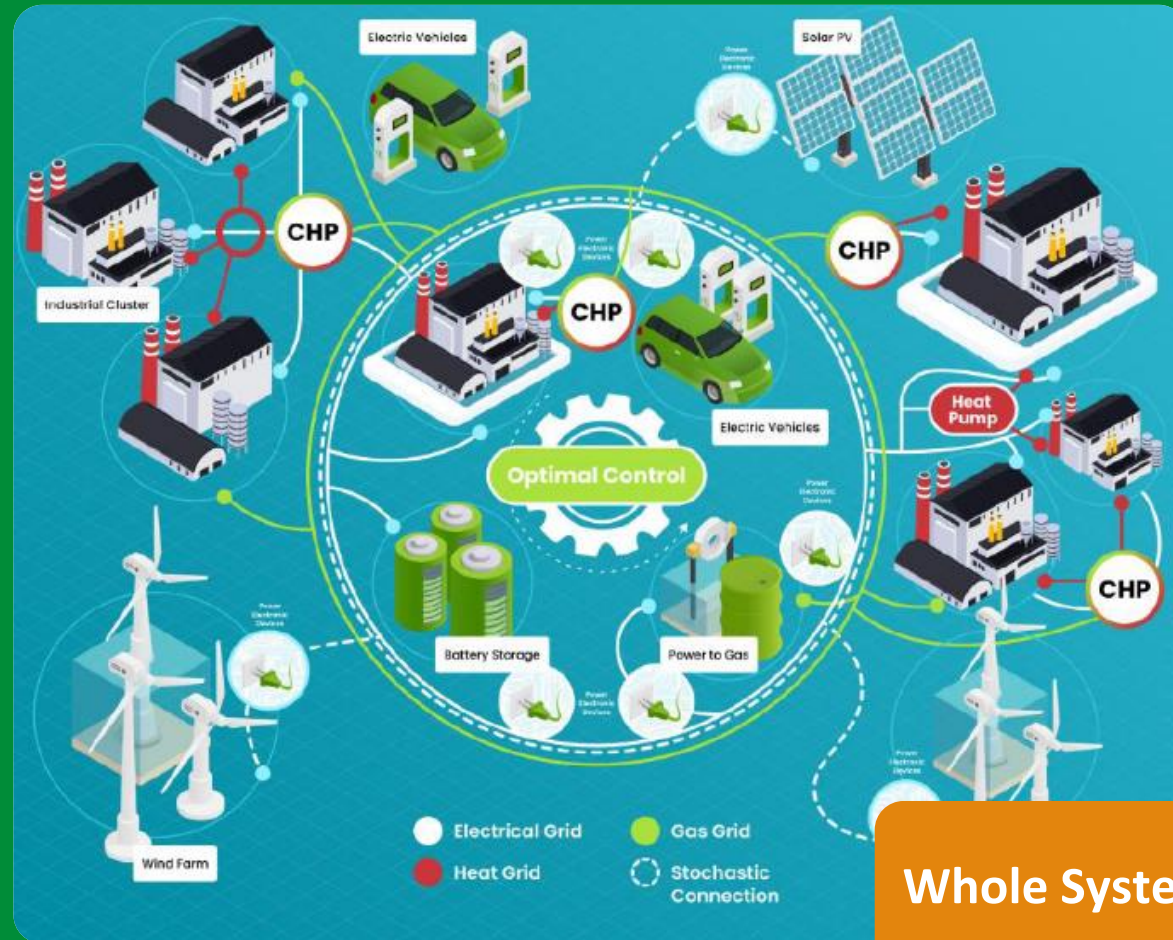- **Developing Options to Manage Peaks in Load**
- **Supporting the Development of New Business Models and Markets**
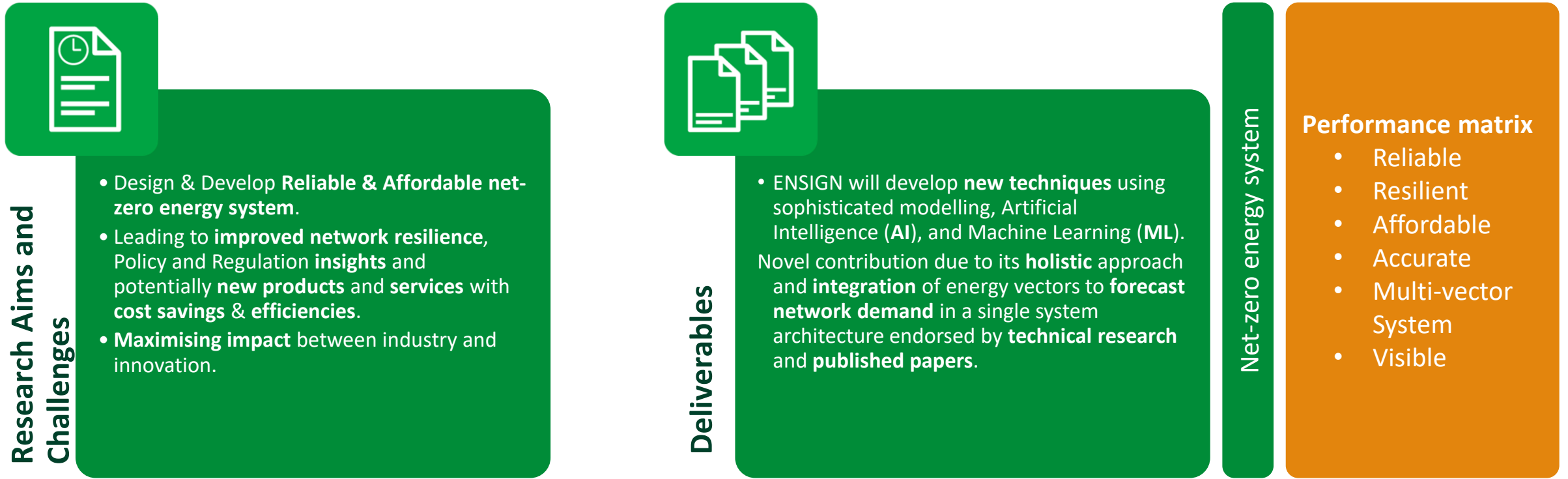- **Investing in the Digital Skills of our People**
- **Improving Mastery of our Data**

Whole System approach to represent energy networks in **real time**

ENSIGN : ENergy System dIGital twiN

SP Energy Networks

Project is expected to **deliver new knowledge and understanding** of **future energy systems** and create more than **20 new highly skilled** academic research **jobs** and **PhD positions**, addressing **industry-driven challenges** and delivering **economic** and **societal impact** for **sustainability** and **prosperity**.

Research Aims and Challenges

- Design & Develop **Reliable & Affordable net-zero energy system**.
- Leading to **improved network resilience**, Policy and Regulation **insights** and potentially **new products** and **services** with **cost savings** & **efficiencies**.
- **Maximising impact** between industry and innovation.

Deliverables

- ENSIGN will develop **new techniques** using sophisticated modelling, Artificial Intelligence (**AI**), and Machine Learning (**ML**).

Novel contribution due to its **holistic** approach and **integration** of energy vectors to **forecast network demand** in a single system architecture endorsed by **technical research** and **published papers**.

Net-zero energy system

Performance matrix
- Reliable
- Resilient
- Affordable
- Accurate
- Multi-vector System
- Visible

ENSIGN is a **pioneering initiative** that intersects **digital innovation**, **energy system transformation**, and **asset management** for the distribution network, towards achieving net zero emissions by 2050.

ENSIGN – Applications for Asset Management

SP Energy Networks
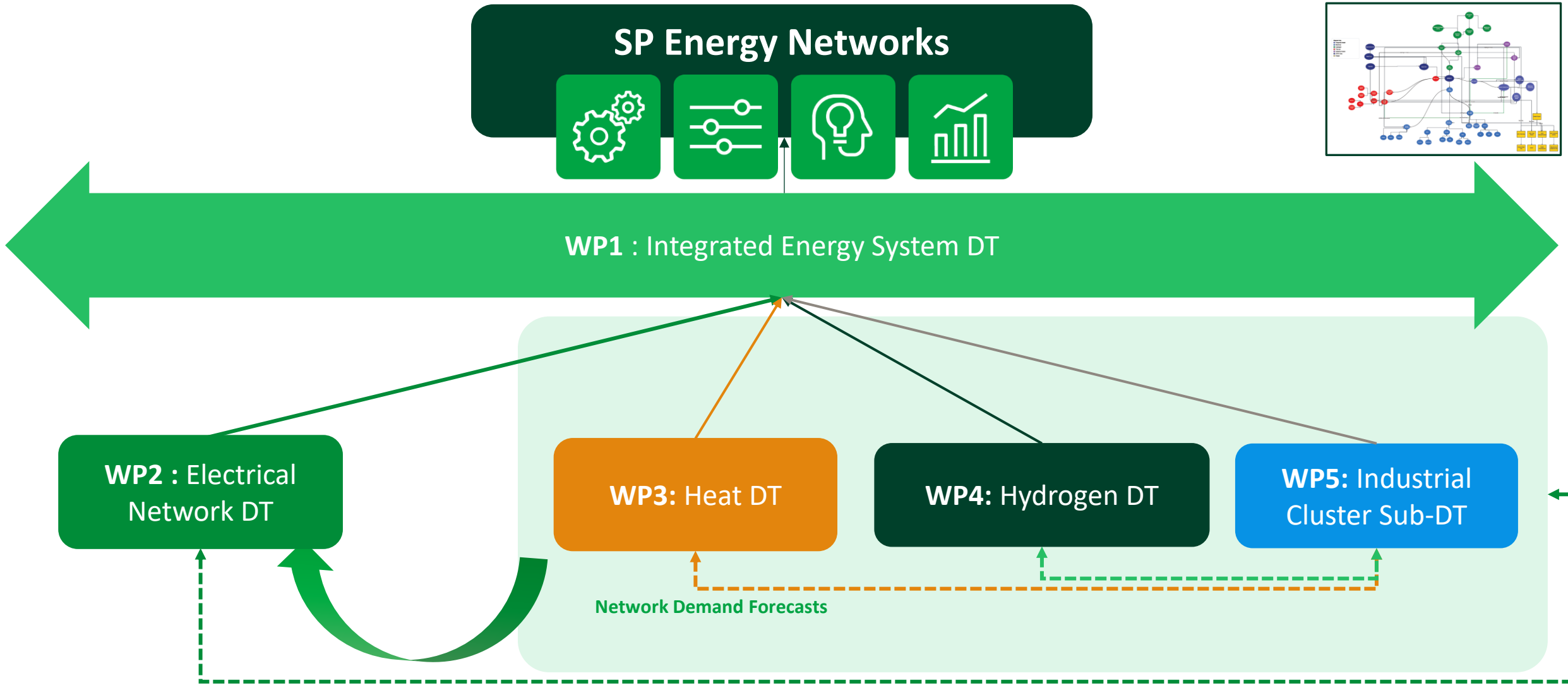
Automate
Automate tasks that are currently performed manually.

Identify & Predict
Identify and address network performance issues before they occur.

Real-Time
Utilise and integrate data (towards) real time.

Simulate & Optimise
Forecast future energy needs for potential scenarios.

- **Automate** monitoring & management of the performance of assets.
- **Predict** when assets likely to fail.

Asset management

- **Optimise** the performance of the distribution network by **simulating** different scenarios

Network Optimisation

- **Identify** and **automate** fault diagnosis in the distribution network before they occur.
- **Simulate & optimise** remedial action.

Fault Detection and Diagnosis

- Provide employees with a safe and controlled, **simulated** environment to practice their skills and test new procedures.

Training and Education

Applications for ENSIGN in SPEN

Automate	Identify & Predict	Real-Time	Simulate & Optimise
Automate tasks that are currently performed manually.	Identify and address network performance issues before they occur.	Utilise and integrate data (towards) real time.	Forecast future energy needs for potential scenarios.

Asset management
- **Automate** monitoring & management using **real-time** condition data.
- **Predict** failures
- **Simulate** modernisation solutions.
- **Optimise** maintenance

Network Optimisation
- **Optimise** asset performance
- **Simulate** impact of new energy sources to the grid
- **Automate** location selection for a new substation.

Fault Detection and Diagnosis
- **Automate** fault diagnosis
- **Simulate & optimise** remedial action

Training and Education
- Provide employees with a safe and controlled, **simulated** environment

Key Challenges

Three key themes have been identified when considering the challenges to be addressed to enable achieving Net Zero, while delivering a safe, reliable and resilient network.

- Forecasting the **future demand profiles**
- **Prioritise reinforcement** on the network for **LCT uptake**.
- Understand if we can **influence behaviours** to **avoid major variations** in demand.

- Develop **resilient** and **intelligent automation** and **protection** tools to guard against faults.
- **Test** and **assure scenarios** for restoration.
- **Optimise** possible **reconfigurations** of the network.

- **Predict** the **impact** of climate change on the distribution network and our assets.
- **Prioritise modernisation** for regions of the network in **Severe Weather Areas**.
- Develop **enhanced mobilisation** plans for forecast storms.

Future Demand for Net Zero

Electricity System Restoration

Climate Change Resilience

The ability to simulate potential scenarios and how they influence operation and configuration of our network will maximise the benefit and impact of this initiative.